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agronomy news

A Tale of Two Ballot Initiatives

Concerns about potential groundwater contamination, odor, and neighboring property values are behind Confined Animal Feeding Operation initiatives.

INSIDE THIS ISSUE:

Large confined swine feeding operations have significantly increased in eastern Colorado since 1990. Citizen concerns about potential groundwater contamination, odor, and neighboring property values have been expressed in some of our communities. Although few known water quality problems exist because of swine feeding operations in Colorado, the 1997 legislature attempted to address these concerns by amending the current state water quality laws. This legislation was eventually tabled, and, as a result, concerned citizens have taken matters into their own hands.

Two ballot initiatives have been filed with the Secretary of State and have been approved for the November 3 election. If passed, these initiatives may change the requirements on confined animal feeding operations (CAFOs) in Colorado. The first initiative is numbered Amendment 13 and entitled "Uniform Regulations of Livestock Operations." This initiative, sponsored primarily by the animal feeding industry in Colorado, would amend the state constitution to require that all regulations concerning livestock must be uniform across all species raised for profit.

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Two Initiatives

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The second initiative of interest, Amendment 14, entitled Reglation of Commercial Hog Facilities, is a provision that would amend the Colorado Water Quality Control Act to regulate commercial swine feeding operations. This initiative is similar to Senate Bill-088, which was introduced but failed in the 1998 legislative session.

On the surface Amendment 13 may seem simple. However, if both initiatives pass, the intent of the animal industry is that Amendment 14 will be rendered unconstitutional due to Amendment 13. Whether all confined feeding operations will be subjected to more stringent regulations due to this initiative is uncertain. How the voters interpret the language of the two initiatives will depend on the effectiveness of the media blitz prior to the election. As you might anticipate, the large population of voters living along the Front Range generally decides these initiatives.

Amendment 13:

- Any state law that does not treat livestock operations which have similar potential impacts on the environment in a uniform manner is unconstitutional.
- "Livestock" includes cattle, sheep, goats, swine, mules, poultry, horses and all other animals raised for profit.
- The legislature may distinguish between range fed and confined livestock and may distinguish between operations smaller and larger than 1,000 animal units.

Amendment 14:

- This initiative will amend the current CAFO regulations to require a discharge permit for any swine operation capable of housing 800,000 lbs. of live animals.
- A detailed agronomic analysis and waste management plan must be approved by the Water Quality Control Division of the Colorado Department of Health and Environment. The agronomic rate cannot be exceeded, or the state is required to take immediate enforcement action.
- Financial assurance must be provided for the final closure of swine operations.
- Any waste spill must be reported to the state and county within 24 hours.
- Quarterly waste management and groundwater monitoring reports must be filed with the state.
- All new or expanded anaerobic lagoons shall be covered immediately; existing anaerobic lagoons have until July 1, 1999 to install covers and gas recapture devices.
- No new swine waste storage or application site may be located within one mile of an occupied dwelling without written consent of the owner or within one mile of a school or a municipality without the proper written consent.
- A fee of up to $0.20 per animal may be assessed for the permit program.
- Citizens' suits may be filed by anyone adversely affected by commercial swine operations.

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Hog Industry Growing In Eastern Colorado

Available resources draw more operations with higher inventory.

The swine industry is growing rapidly in eastern Colorado due to the availability of water and grain, favorable conditions for bio-security, low population densities, and state regulations which are less restrictive than in other states.

In 1988, when the hog industry started establishing its facilities in Colorado, National Hog Farms built a 17,000-sow enterprise in Weld County. Besides National Hog Farm Enterprises, other swine feeding operations in Colorado include:

- Newsham Hybrids, Inc. near Lamar
- Kansas-based Seaboard Corporation in Sedgwick County
- D & D Farms of Huron, South Dakota, in Phillips County
- Alliance Farms, a cooperative affiliated with Farmland Industries in Yuma County
- Western Pork Production Company (investor-backed) in Yuma County
- Midwest Farms of Wisconsin in Kit Carson County.

Each of these facilities has a capacity of 20,000 sows. Most recently, Bell Farms of North Dakota has built and is expanding in Bent County.

According to the 1998 Colorado Agricultural Statistics:

- The breeding herd in Colorado is currently at 160,000 head, which represents an eight-fold increase since 1984. At that time, the herd size had dwindled to 20,000 head since family-owned operations were affected by the agricultural recession in the 1980's.
- The Colorado market hog and breeding inventory is currently 790,000 head as compared to 210,000 head in 1984.
- Hog industry cash receipts have increased in Colorado from $48,494,000 in 1984 to $201,696,000 in 1997.

Mahdi Al-Kaisi
Regional Water Management Specialist
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Two Initiatives

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Clearly, the provisions of Amendment 14 constitute a major shift in the state policy toward confined swine operations. The impact on the existing swine industry is not certain at this time. However, owners contemplating new or expanded facilities will undoubtedly view Colorado's regulatory climate very differently than in the recent past.

Reagan Waskom
Extension Water Quality Specialist
Department of Soil and Crop Sciences

Economic Issues Are Central To Ballot Initiative Debate

Confined animal feeding operation regulations address environmental and health concerns, employment opportunities, real estate values, and governmental involvement, all of which have economic consequences.

Proposed Amendments 14 and 13 will have economic impacts on Coloradoans no matter which way they are decided. As state level initiatives, responsibility for financing falls to the state's taxpayers. The majority of livestock operations are located in rural areas, and rural Colorado communities will be most affected by the outcomes of these votes (for example, impacts on environment, employment, real estate values, and local infrastructure and services). Regulations designed to protect the environment increase the costs of production and decrease the profitability of hog operations. Voters must determine whether the social, economic, environmental and governmental impacts of these policies are appropriate.

Amendment 14

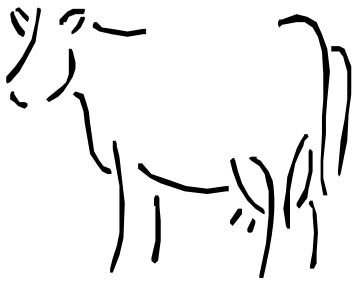
Proposed Amendment 14 includes the following provisions for which economic information is available: state budget impacts and fees, set-back requirements, financial assurance, and odor reducing technologies.

State Budget Impact

Amendment 14 will require approximately $233,000 annually to pay for new regulatory and enforcement activities. A $0.20 per animal surcharge is attached to animal sales in Amendment 14 to defray these expenses. Colorado has a market inventory of about 700,000 hogs and pigs. Therefore, the surcharge should cover about 60% of the cost to the state exclusive of any changes in sales, income, or property tax revenues attributable to the initiative.

Set-back Requirements

Amendment 14 requires that new swine operations are located at least one mile from any residence, school or church in order to reduce odor impacts on neighbors. Farms must also be located a safe distance from any site at risk of contamination (e.g. wellheads, rivers). These requirements do not impose any cost to swine operations (except, perhaps, slightly higher transportation costs) since the operator is not required to own or lease the set-back land. Since swine operations are generally thought to have a negative influence on neighboring land values, this "good neighbor" requirement acts as a subsidy to the industry. The industry benefits from not having to pay for the land, is protected because of the odor reducing effects of being located away from potential complainants, and does not reduce neighboring property values in any large way.



Financial Assurance

Amendment 14 requires swine operations to provide financial assurance to be used to clean up any spills they might cause and to return the land to its original state should the operation close. The

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Economics

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financial assurance provision is commonly covered by insurance. The establishment of a fund to return land to its original state is called a bond, and is required of industries considered at high risk of creating environmental damage (for example, mining operations).

Odor Reducing Technologies

Amendment 14 requires the use of technologies to minimize odor emanating from confined hog operations. Covered anaerobic lagoons and incorporation of effluent into the soil are common odor mitigating technologies. The annual estimated cost of covering anaerobic lagoons with plastic is $11.07 per sow. The annual cost of incorporating effluent is $1.39 per sow or $0.13 per gallon more than broadcast application from a lagoon.

Amendment 13

Proposed Amendment 13 is likely to have at least two types of economic impacts on livestock operations in Colorado. First, the regulatory environment should be simplified because all livestock regulations will be consistent across species after calculating an animal unit equivalent. A simpler regulatory environment could result in cost savings in monitoring and enforcement. However, simplifying the regulatory environment will only be socially desirable if all species are equivalent polluters on an animal unit basis. Thus, the second possible change in the regulatory environment will be construction of an overly restrictive framework since our tolerance for pollution risk is defined as the same across species. Standards will be set based upon the species posing the greatest pollution threat, leaving those species posing lesser risk to society with stricter regulations than are necessary to manage their pollution risk. Regulations that are more stringent are more costly to livestock operations and to regulators than are less stringent standards. The net economic impact of this Initiative depends upon the difference between these two effects and cannot be estimated at this time.

Conclusions

Amendments 13 and 14 will have social, environmental, governmental, and economic impacts on (mostly rural) Coloradoans. These impacts may be positive or negative, large or small, explicit or implicit, intentional or unintentional depending on the community. Some of the explicit economic issues found in these Initiatives were reviewed here. Many more issues remain unexplored. Consideration of economic issues constitutes a part of a broad view of these Initiatives, and contributes to an informed decision on behalf of current and future Coloradoans.

Andrew Seidl
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Department of Agricultural and Resource Economics
and
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news

The proposed **Unified National Strategy for Animal Feeding Operations is available for review and comment.** Designed by the United States Department of Agriculture and the Environmental Protection Agency to improve America's water quality and reduce public health risks associated with animal feeding operations, the draft strategy proposes that all animal feeding operations develop and implement nutrient management plans by the year 2008. You can obtain a copy of the draft strategy by calling EPA's Water Resource Center at (202) 260-7786, or from two websites: http://www.nhq.nrcs.usda.gov/cleanwater/afo/ or http://www.epa.gov/owm/afostrat.htm . Comments are due January 16, 1999, and should be sent to Denise C. Coleman, Program Analyst, USDA - NRCS, PO Box 2890, Attention AFO, Washington, DC, 20013-2890.

Water Quality Concerns Are Key To CAFO Regulation Initiatives

Preventing water quality degradation is the goal; what are the facts?

The current CAFO regulations and proposed Amendment 14 focus on preventing water quality degradation from manure and waste water. Advocates of more stringent regulations invariably state that much tighter controls are needed to protect our water supplies. This presupposes that CAFOs are currently degrading Colorado surface and ground water. Are there data to support these suppositions and assertions? In this article we will examine some potential and actual water quality impacts from CAFOs.

What are the potential CAFO impacts to water quality? The U.S. EPA estimates that 25% of all surface water degradation in the U.S. can be attributed to livestock production. Potential pollutants include nutrients, pathogens, salinity, sediments, and metals degrading water so that it is unfit for drinking, swimming or fishing. Biochemical oxygen demand (BOD) is also a commonly reported measure of pollution potential because animal wastes contain a high level of organic matter. Extreme cases of CAFO impacts such as the 1993 Cryptosporidium outbreak in the Milwaukee water supply that sickened an estimated 400,000 people or the 25 million gallon swine effluent spill in North Carolina in 1995 are often cited as pertinent examples of water quality impacts from CAFOs. The 1997 outbreak of the toxic microbe Pfiesteria caused an estimated 500,000 fish deaths in the eastern U.S. as well as human sickness, which led to more calls for enhanced regulation of CAFOs.

In Colorado there are no such dramatic examples of water pollution from CAFOs, but the potential does exist wherever manure is generated and stored in proximity to surface or ground water. Phosphorus enriched runoff to surface water causes algal blooms that may result in fish kills, clogged pipelines, or impaired recreation. Nitrate leaching to ground water causes degraded drinking water quality that may result in expensive cleanup procedures for public water suppliers. Metals, sediments, BOD, and salts from animal wastes are primarily a concern for surface water. Pathogens such as bacteria, viruses, and single cell organisms like Cryptosporidium can reach ground water, but tend to be a much more serious threat to drinking water that comes from surface water supplies.

Which areas are likely to be vulnerable to water contamination? Surface water tends to be scarce in eastern Colorado, where most of the state's CAFOs are located. As a result, we rarely hear of serious contamination problems occurring in Colorado as have been cited in the eastern U.S. However, since recreational and aesthetic surface water bodies are few and far between in Colorado, it is important to protect these resources. This summer one lake in eastern Colorado was closed to body contact for over a week after a fish kill occurred following a hard rain in proximity to a CAFO. While this case was not conclusively linked to the CAFO, anytime there is a concentrated manure source near surface water, special precautions are necessary. Therefore, it can be said that feeding operations in close proximity to drainageways, canals or streams are likely to impact surface water unless the appropriate retention and diversion structures are in place.

Ground water vulnerability is more difficult to assess, yet certain principles are known. Anywhere ground water is shallow (<50 feet deep) and overlain by coarse, sandy soils it can be considered vulnerable to contamination, especially if the area receiving animal waste is irrigated. Once nitrate has leached below the crop rootzone there is

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Water Quality

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little to impede its travel to ground water unless there is an impermeable zone above the aquifer. Some areas in Colorado that are known to have vulnerable ground water include the South Platte alluvial aquifer, the San Luis Valley unconfined aquifer system, the Arkansas River alluvial aquifer, and areas of the High Plains aquifer near Wray. These areas and other similar regions merit reasonable precautions to protect existing water quality and uses. The Ogallala is a sole source aquifer for drinking water for many eastern Coloradoans and should be protected from contamination by animal waste and other pollutants. Aquifer protection and animal production are compatible in most cases in Colorado if the appropriate precautions are observed.

Are there documented water quality impacts from Colorado CAFOs? The Colorado Department of Public Health and Environment began sampling rural domestic wells under SB 90-126 in 1992 to analyze for the presence of nitrate and other chemicals. Nitrate analysis of groundwater has shown that on average 15 to 20 % of rural domestic wells in agricultural areas exceeded the nitrate drinking water standard of 10 mg/L. Testing in the S. Platte alluvial aquifer indicated that over 35% of the wells in the basin examined exceeded drinking water standards for nitrate.

The S. Platte alluvial aquifer from Denver to Julesburg is one of the most studied aquifers in the state. One reason is that a number of small towns have had to acquire alternative water sources or install treatment in order to meet the federal nitrate drinking water standard. Tens of millions of dollars have been spent on acquiring clean water for these towns, and there has been much interest in determining the source of nitrate in the water. The U.S. Geological Survey estimates that manure contributes over 90,000 tons of nitrogen and 25,000 ton of phosphorus to the S. Platte River basin each year, compared to 7,000 tons of nitrogen and 2,500 tons of phosphorus annually from all waste water treatment plants. They also found that nitrogen isotope data indicate that manure is the primary source of ground water nitrate in the Greeley area. In areas east of Greeley in the S. Platte alluvial aquifer, manure and fertilizer nitrogen were found to be equally important sources of ground water nitrate.

In the High Plains of Colorado there is considerable animal feeding but little documented evidence of ground water impacts. One swine feeding operation near Yuma found elevated nitrate levels below their fields and realized that there was inadequate communication between the crop producer who was applying commercial fertilizer and the operators of the waste lagoons. In the San Luis Valley where there is little concentrated feeding, an analysis of nitrogen isotopes by the U.S. Geological Survey indicated that nitrate contamination of wells was primarily a result of commercial fertilizer leaching. These nitrogen isotope studies have not yet been undertaken in any other basins in Colorado because of their high cost. In general, other basins in Colorado do not have known widespread or persistent ground water problems due to CAFOs.

Clearly, there are potential and documented water quality concerns surrounding CAFOs in Colorado. Are the threats as immediate and dire as the supporters of Amendment 14 claim? Probably not. However, livestock feeders must be motivated to protect water resources through proper planning and management; either through their own environmental ethic or by regulatory requirements.

Reagan Waskom
Extension Water Quality Specialist
Department of Soil and Crop Sciences

Follow Your Nose To Any Confined Swine Feeding Operation

Odors are possible at every stage of swine production, and there are a variety of ways to reduce the stinky problem.

Confined swine operations create odors due to the methods employed in producing the animals and handling the waste. The manure is diluted with water for transport from the swine housing units to the manure holding facilities (lagoons) and finally to the fields for land application. Each of the steps in storing and processing the manure can produce odor.

Swine operations produce a number of air quality hazards for workers, as well as for the pigs. Gases, dust, infectious agents, and airborne bacteria may cause chronic respiratory problems and death in certain situations.

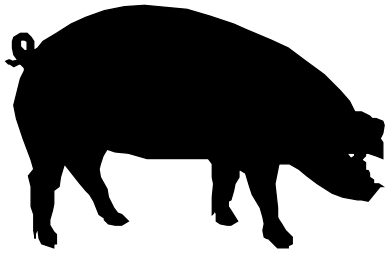
Odor is often a major concern for neighbors of confined swine operations. Odor comes from ammonia, hydrogen sulfide gas, volatile fatty acids and traces of other compounds. Odor problems are difficult to address because:

- reaction to odor varies among individuals
- odor is difficult to measure and establish limits
- there is no agreement on health effects of odor
- mental health problems from odors are not well understood.

Neighbors are subjected to relatively dilute levels of odor-causing compounds from hog operations. Thus physical problems are unlikely for neighbors, as compared to swine facility workers. However studies have shown a variety of mental health problems in varying degrees: tension, depression, anger, fatigue, confusion, and lack of vigor.

The most common way for local authorities to deal with odor issues is to require separation distances between the swine facility and its neighbors. This distance may be as little as one fourth mile or as much as three miles. A separation distance is generally based on political considerations as much as science. Some state and local authorities are requiring additional procedures including:

- covering manure holding facilities
- aerating lagoons
- incorporation of land applied manure within 24 hours
- evidence of an adequate land base for manure application
- training of manure handlers.



There are other operating procedures a swine operation may adopt to reduce odors, including:

- maintaining a clean facility
- adequate ventilation
- modifying animal diets
- proper design of lagoon facilities
- proper timing of land application
- proper disposal of dead pigs
- planting trees around lagoons, fields and production facilities.

New technology may also be employed to reduce odors, including:

- biological and chemical scrubbers and filters on the ventilation system
- employing techniques commonly used in municipal waste treatment facilities
- improved building design.

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Department of Chemical and Bioresource Engineering

Is Hog Manure Worse Than Other Kinds of Manure?

A pound-for-pound comparison of production, content, and pollution potential.

Part of the justification for special regulation of hog manure is that it is perceived to be worse than other livestock manure or human waste. "Worse" manure could be due to greater quantity or poorer quality.

Do hogs produce more manure? When comparing pigs to cattle or humans, it's important to compare them based on equivalent weights. For 1000 lbs of animal, nursing pigs excrete the greatest amount of manure, followed by dairy cows. Growing pigs excrete just slightly more than beef feeder cattle, and all of the livestock in this comparison excrete considerably more than humans (on a pound-for-pound basis).

On the other hand, wastewater production is greatest for humans because of our high water usage for bathing and cleaning, in addition to flushing. Hogs produce less than one-third of human wastewater output. Dairy wastewater output is much less than hogs, because most of the manure is usually handled in the solid form, and flushing is only used for the milking areas. Beef feedlots can produce stormwater runoff which contains some manure, but most of the manure is handled as a solid.

- Pigs produce 2-3 times the amount of manure as humans, BUT they produce less than one-third the amount of wastewater.
- Nursing pigs produce more manure than cattle, BUT growing pigs produce about the same amount of manure as feeder cattle and less than dairy cattle.
- Pigs produce more wastewater than other livestock because all of the waste is usually handled in liquid form.

Is hog manure worse? Liquid manure tends to be less concentrated in nutrients, salts, and heavy metals than solid manure. This is simply because of the dilution due to the added water.

In the summer of 1996 we did a "manure survey" collecting over 150 manure samples from around Colorado. There were 33 liquid manure samples which were approximately half dairy and half hog.

	Manure Production (lb/day/1000 lbs)	Wastewater Production (ft^3/day/1000 lbs)
Nursing Pig (0-40 lbs)	106	28
Growing Pig (40-220 lbs)	63	16
Dairy Cow	80-85	1-2 (milking center only)
Beef Feeder	51-59	0
Human	30	90

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Hog Manure

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Nutrients

Liquid manures are generally less concentrated in plant nutrients than solid manures. Liquid hog manure is more concentrated than liquid dairy manure in all of the major plant nutrients. This means it is a more valuable fertilizer, but it also means overapplication is more risky. In addition, the NH_4-N level is higher in the hog manure, which contributes to its greater ammonia odor.

Heavy Metals

Sewage biosolids (sewage sludges) are regulated according to their heavy metal content. In order to determine whether heavy metals should be of concern in manure management, we measured heavy metals in our manure survey. In general, liquid manures had lower heavy metal contents than solid manures, even when reported on a dry weight basis.

Many heavy metals were non-detectable (present in concentrations so low that they could not be measured) in the liquid hog manure samples: molybdenum, lead, cadmium, chromium, nickel, titanium, and vanadium. Zinc, iron, strontium, and barium were measurable, but their concentrations were lower than the solid manures.

Copper and boron were the only metals which had higher concentrations (on a dry weight basis) in the liquid manures than the solid manures. Both copper and boron are essential plant nutrients. The copper levels were nearly identical for the liquid dairy and liquid hog manures, and boron concentration was four times higher in the dairy manure than in the hog manure (on a fresh weight basis).

Nonetheless, all of the liquid hog manure samples were within the maximum concentrations to be considered Grade 1 biosolids. Therefore, the heavy metal concentrations in liquid hog manure are safe for agricultural use.

- In general, liquid manures have lower nutrient, salt, and metal concentrations than solid manures.
- Nutrient concentrations are higher in liquid hog manure than liquid dairy manure, but salt content is lower in the hog manure.

	N (lb/1000 gal)	NH_4-N (lb/1000 gal)	P_2O_5 (lb/1000 gal)	K_2O (lb/1000 gal)
Dairy	0.3	0.2	0.4	2.0
Hog	1.3	0.6	0.8	5.7

Salts

Electrical conductivity (EC) is a measure of salt content. The higher the EC, the greater the concentration of salts, and the greater potential for salt buildup in soils and salt damage to crops. In our survey, the liquid manures had significantly lower salt contents than the solid manures, and the liquid hog manure EC was only 3 mmhos/cm, half of the value for liquid dairy manure. Among the solid manures, horse manure had the lowest salt content with an average of 6 mmhos/cm, and beef had the highest EC (28 mmhos/cm). Composted manures had higher EC values than non-composted manures.

So, is hog manure worse? Hogs produce more wastewater than cattle, but concentrations of nutrients, salts, and metals tend to be lower in liquid hog manure than in solid cattle manure. No, hog manure is not worse, but it is different, and it must be managed appropriately to make use of the nutrients without polluting the environment.

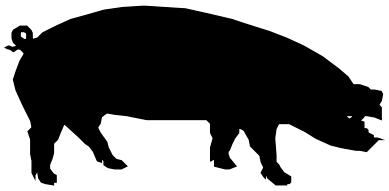
Jessica Davis
Extension Soil Specialist
Department of Soil and Crop Sciences

Recycling Pig Manure As Fertilizer

Proper application rates can mean higher yields for irrigated corn without pollution problems.

The results of the swine effluent study that CSU undertook from 1995 to 1997 have been finalized. This study was conducted on a sprinkler irrigated cornfield in Yuma County, Colorado. The objectives of the study were to evaluate swine effluent as crop fertilizer and to establish Best Management Practices for using swine effluent on sprinkler irrigated fields. Also, the study compared the impact of swine effluent to the impact of commercial nitrogen fertilizer in two main characteristics: nitrate buildup in the soil profile and corn yield performance.

We found that the nitrogen in swine effluent from the two-stage lagoon was mostly in the form of ammonium-nitrogen (NH_4-N). This is significant because NH_4-N is completely available to the crop, the same as most commercial nitrogen fertilizers. Ammonium-nitrogen has the ability to attach to the soil as compared to the nitrate form of nitrogen (NO_3-N), which is more susceptible to leaching. The nitrate content of swine effluent was less than 1% of the total nitrogen. Therefore managing swine effluent becomes similar to managing commercial fertilizer as applied through chemigation systems. Swine effluent can be managed on irrigated fields in a manner similar to commercial fertilizer by using proper application rates and timing to minimize any potential nitrogen leaching to the groundwater.



If handled properly, swine effluent can be used as a nitrogen source for crops as safely as commercial nitrogen fertilizers. When swine effluent was applied at agronomic rates, NO_3-N did not leach below the rootzone. The study investigated any additional management difficulties of effluent applications compared to commercial nitrogen fertilizer, and identified application and management techniques best suited for northeastern Colorado.

We found a significant increase in corn yield by as much as 26-30 bushels/acre for swine effluent as compared to commercial nitrogen fertilizer. This yield increase was probably due to the additional nutrients (phosphorus, potassium, zinc, and iron) in swine effluent. It was found that nutrient uptake was much greater under swine effluent than under commercial fertilizer, which was one of the factors that contributed to higher yield.

Our study showed no significant nitrogen leaching or soil nitrogen build up when swine effluent was used at agronomic rates. Using swine effluent as fertilizer is a sensible way to recycle nutrients to crops by using Best Management Practices that will insure proper application rates, proper timing, and soil and effluent testing. The impact of swine effluent or any fertilizer on ground water quality and nitrate leaching depends on site-specific factors such as soil texture, soil moisture, effluent application rate, precipitation, and the amount of nitrogen available in the effluent. Swine effluent can be used as a fertilizer in a manner that optimizes crop yield and protects water quality at the same time.

Mahdi Al-Kaisi
Regional Water Management Specialist
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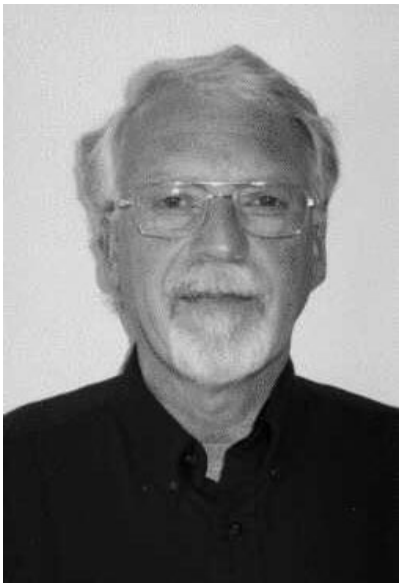
events

October 12: League of Women Voters will host a discussion of all ballot initiatives, including the confined animal feeding initiatives, 3:30 to 7 p.m., Montview Presbyterian Church, 1980 Dahlia Street.

meet. . .



KENNETH G. DOXTADER is a professor in the Department of Soil and Crop Sciences at Colorado State University. His research and teaching are in soil microbiology and environmental soil science. Recent projects have included examining the degradation of pesticides and toxic organic compounds by microorganisms, bioremediation of petroleum-contaminated soil, microbial transformations of soil organic matter, and ecology of microorganisms in soil. Dr. Doxtader is currently advising a graduate student who is studying the impact of manure application on soil microbe and earthworm populations.

Doxtader holds the B.S. in Soils and Plant Nutrition from University of California, Berkeley, and the M.S. and Ph.D. in Soil Microbiology from Cornell University.

The Other Side Of The Story: What's So Great About Manure?

Manure management means finding ways to benefit from manure production without polluting water and air.

Manure has been used as a fertilizer and soil amendment since humans started cultivating plants. In addition to its fertilizer nutrient supply, manure is a terrific soil amendment for a number of reasons.

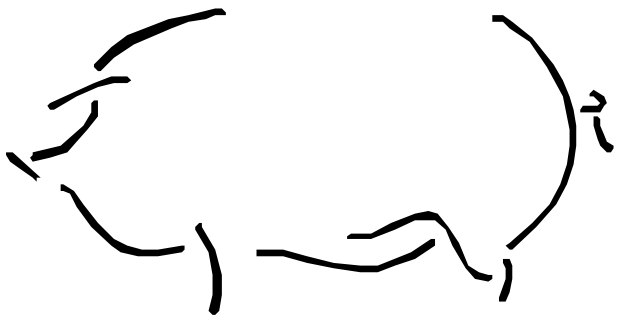
- Manure replenishes soil organic matter and soil microbial activity.
- Manure increases a soil's nutrient holding capacity and, therefore, prevents nutrient leaching.
- Manure improves soil structure and drainage.
- Manure enhances a soil's ability to store water for plants to use.
- Manure supplies numerous micronutrients to plants in addition to nitrogen, phosphorus, and potassium.

There are other lesser known uses of manure, such as:

- Manure can be used as livestock feed.
- Manure can be burned as fuel or converted to electricity through methane digestion.
- Manure can even be used for brick making and building construction!

Our goal in manure management is to get the benefits out of manure while preventing water and air pollution. So let's not throw the baby out with the bathwater! Let's use manure wisely and make all of our lives better for years to come.

Jessica Davis
Extension Soil Specialist
Department of Soil and Crop Sciences



web sites

http://www.state.co.us/gov_dir/leg_dir/lcsstaff/ballot/toc.htm
Colorado General Assembly—Ballot Analysis
Information on the ballot proposals for Colorado's November election.

http://www.colofb.com/govermental/default.htm
Colorado Farm Bureau
The Colorado Farm Bureau is opposing both amendments #13 and #14.

http://www.nppc.org/
National Pork Producers Council
Includes industry news, research results, educational resources, NPPC Environmental Assurance Program, and "Most Commonly Asked Questions About Pork Production and the Environment."

http://adminsrv.usask.ca/psci/
Prairie Swine Centre, Inc.
Canada's center of excellence in research, technology transfer, and education in sustainable pork production.

http://www.bae.umn.edu/extens/manure/manure.html
University of Minnesota
Manure Application Planner software (demonstration version) for developing manure management plans is available for downloading from this website. Also information on odor, land application, safety, and regulations.

http://www.oznet.ksu.edu/dp_ansi/swine/swine.htm
Kansas State University
Focus on swine nutrition and management.

http://mark.asci.ncsu.edu/waste/default.htm
North Carolina State University
Information on swine manure management, water quality, and odor control.

http://www.nhq.nrcs.usda.gov/cleanwater/afo
http://www.epa.gov/owm/afostrat.htm
Sites with complete draft of the USDA-EPA Unified National Strategy for Animal Feeding Operations.

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